



# Effects of Structured Cryotherapy on Pain, Inflammation, Range of Motion and Edema in Patients with Total Knee Arthroplasty

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## Dear Editor-in-Chief

Total knee arthroplasty (TKA) in Korea is the 8th most frequently performed procedure as of 2014 and the number of patients who underwent the surgery shows an increasing trend from 90.2 persons per 100,000 people in 2009 to 105.8 in 2014 (1). Postoperative pain interferes with persistent passive movement that is critical for the rehabilitation of the knee (2), postoperative pain management is very important. An analysis of postoperative complications in 1,331 patients who underwent TKA from 2002 to 2014 showed that the incidence of infection was highest except for complications that occurred from the artificial joint itself inserted during surgery (3).

The angle of flexion after TKA is important in terms of patient satisfaction and functionality to use the knee without discomfort in daily life (4). Edema is common in the early postoperative period. In the case they are severe, blisters are formed which damage the skin and delay the wound healing at the surgical site (5). To deal with such various factors that delay knee rehabilitation after TKA, non-pharmacologic therapies such as Thera-band Exercise, inelastic pressure bandage application and cryotherapy are implemented. Among them, cryotherapy is more cost effective

than other interventions and possible as an early application; thus, it is used as an independent nursing intervention after TKA. In the ward where this study took place, cryotherapy was applied to the surgery site after TKA. However, it was determined necessary to improve cryotherapy, since nurses apply it inconsistently due to the lack of scientific evidence and of proper information about the method, application times, its frequency and duration.

To this end, we intended to develop a structured cryotherapy while improving conventional cryotherapy to reduce pain, prevent infection, to increase the range of motion (ROM), to alleviate edemas after TKA, and to verify its effectiveness at Chonnam National University Hwasun Hospital in Hwasun, South Korea in 2013.

This study used a quasi-experimental with nonequivalent control group design. The researchers had created a nonwoven fabric with a waterproof pocket attached to maximize the effect of cryotherapy by putting a frozen cold pack to the inside of the pocket and applying it to the surgical site. The cryotherapy applied in this study corresponded to the dry ice method. Thirty patients in the experimental group were applied structured



cryotherapy for 20 min at one-hour intervals for 10-14 times/day during two weeks and 30 control group patients received conventional cold therapy using ice bags or cold packs. Pain intensity was measured by the VAS. The C-reactive protein and erythrocyte sedimentation rate values were used for inflammation extent and the circumference of the lower limb for the degree of edema by tap measurement using tape measure.

This study was approved by the Institutional Review Board of the Chonnam National University Hospital (CNUH-2013-73).

The collected data were analyzed using the SPSS (Chicago, IL, USA) Statistics 19.0. The outcome variables were analyzed by repeated-measures ANOVA and *t*-test.

The intensity of pain of the experimental and control group showed an interaction between the intra-group and the inter-group measurement time ( $F=6.70, P=0.001$ ) and significant differences between the groups ( $F=48.30, P < 0.001$ ) and the measurement time ( $F=165.41, P < 0.001$ ) (Table 1). The erythrocyte sedimentation rate in the two groups was statistically significant ( $t=2.23, P=0.030$ ) on the day 14 after the surgery (Table 1).

**Table 1:** Comparison of outcome variables between the two groups (N=60)

Variables	Time (POD <sup>a</sup> )	Exp. <sup>b</sup>	Cont. <sup>c</sup>	<i>t</i> (P)	F(P)		
		(n = 30)	(n = 30)		Group	Time	Group ×Time
		M±SD	M±SD				
Pain Intensity	#1	7.83±1.49	8.37±1.30		48.30	165.41	6.07
	#3	5.87±1.60	7.53±1.38		(<0.001)	(< 0.001)	(0.001)
	#5	4.80±1.06	6.87±1.68				
	#7	3.87±1.33	6.37±1.73				
	#14	2.41±0.91	4.44±1.50				
CRP <sup>d</sup> (mg/dl)	#3	10.66±5.92	13.48±6.28	1.79 (0.078)			
	#14	1.16±1.14	1.63±1.62	1.29 (0.205)			
ESR <sup>e</sup> (mm/hr)	#3	36.00±19.34	43.27±22.00	1.36 (0.179)			
	#14	22.93±13.51	31.83±17.21	2.23 (0.030)			
ROM <sup>f</sup>	#1	80.17±14.65	46.67±32.41		82.69 (<0.001)	154.65 (<0.001)	6.12 (0.007)
	#3	101.33±6.81	83.17±14.41				
	#5	113.17±10.70	93.17±10.94				
	#7	116.33±9.82	100.33±10.08				
	#14	125.00±5.83	113.40±5.15				
Circumstance of lower limb							
5cm upper	#1	4.70±1.50	5.32±1.65		19.53 (<0.001)	155.00 (<0.001)	5.87 (0.001)
	#3	4.02±1.16	5.50±1.57				
	#5	3.49±1.40	5.14±1.56				
	#7	2.82±1.46	4.83±1.80				
	#14	0.74±0.94	2.50±1.22				
10cm upper	#1	4.67±1.73	5.36±1.61		12.29 (0.001)	145.93 (< 0.001)	1.61 (0.206)
	#3	3.97±1.22	5.29±1.68				
	#5	3.56±1.28	4.93±1.70				
	#7	2.93±1.39	4.29±1.82				
	#14	0.69±1.18	2.10±1.35				

<sup>a</sup>POD=Post operative date, <sup>b</sup>Exp.=Experimental group, <sup>c</sup>Cont.=Control group, <sup>d</sup>CRP=C-reactive protein, <sup>e</sup>ESR=Erythrocyte sedimentation rate, <sup>f</sup>ROM=Range of motion

The ROM of the experimental and control group displayed an interaction between the intra-group and the inter-group measurement time ( $F=6.12$ ,  $P=0.007$ ) and significant differences between the groups ( $F=82.69$ ,  $P< 0.001$ ) and the measurement time ( $F=154.65$ ,  $P< 0.001$ ) (Table 1). The degree of edema in the two groups exhibited an interaction between the intra-group and the inter-group measurement time for 5 cm above the knee ( $F=5.87$ ,  $P< 0.001$ ) and which was statistically significant ( $F = 19.53$ ,  $P< 0.001$ ) and the time ( $F=155.00$ ,  $P< 0.001$ ) (Table 1).

The results confirmed that the application of structured cryotherapy was effective in reducing pain, relieving inflammation, reducing edema, and increasing ROM in patients with TKA compared to conventional cold therapy. It is reckoned that structured cryotherapy can be utilized as a useful nursing intervention to facilitate the postoperative rehabilitation of patients with TKA.

## Conflict of interest

The authors declare that there is no conflict of interest.

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